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NOTES ON THE EARLY STAGES OF THE EUROPEAN PINE SHOOT MOTH*

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When the European pine shoot moth was first found in North America in 1914, considerable interest was aroused by the discovery and no less fear regarding the potentiality of the insect as a menace to native forests and pine plantations. As the years went by and the pest appeared to be confined mostly to nursery stock and ornamentals, much of the original interest waned only to be rather suddenly revived by recent reports of widespread damage to certain pine plantations both in Canada and the United States. These late inroads of the pine shoot moth are such that the time-honoured method of control by cutting out infested buds is gradually becoming a practical impossibility and new methods in dealing with this insect are being sought by the forest entomologists of the New World. Since the success of their experiments will depend largely upon a correct knowledge of the life history and habits of the species, this article is contributed in the hope that facts presented may be of value to other workers, particularly those engaged in control experiments.

During the greater part of its life the larva of the European pine shoot moth is effectively protected from chemical methods of control by the walls of the bud within which it feeds. It appears to be most vulnerable in the egg stage and the first two larval stages, these will be briefly considered in the subsequent paragraphs. The observations on which the following notes are based were made in 1932 at the Cedar Bay Laboratory on the north eastern shore of Lake Erie.

The egg stage.—The period of oviposition may be said approximately to correspond with that of adult flight. The pre-oviposition period is probably very short since, in the laboratory, eggs were obtained one day after the emergence of the first females. The simultaneous appearance of the eggs in the field seems to indicate that, in this respect, no insignificant difference will be found between laboratory and field conditions.

The eggs are laid singly or in groups of two to ten or twelve. They are found mostly on the new shoots, although a few may be deposited on the twigs and needles of the previous year. On the new growth, they occur on the stem, often in the axils of the needles, sometimes on the needles themselves and also on the buds or at the base of buds. The greater number of eggs was found at some distance from the buds, somewhere on or near the basal third of the new shoots. Figure 1, shows these locations on a part of shoot from which some of the needles were removed. When freshly laid, the eggs are opaque whitish; they soon become light yellow and gradually assume a deeper orange colour. Just before hatching they turn greyish and the black head capsule of the larvae is plainly visible through the shell. After reaching its complete de-

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velopment the larva remains at rest in the egg shell for about 24 to 36 hours. Figure 2 shows an egg as it appears when freshly laid. Figure 2a represents an egg two days old. Figures 3 to 7 show the embryo as it may easily be observed through the shell on the 7th, 8th, 9th, 10th, and 11th days. The larva from which these drawings were made hatched early in the morning of the 12th day after oviposition. Considerable variation was noticed in the length of the embryonal period. Thus, eggs laid during the last half of June hatched in 15 to 18 days, whilst those laid about the middle of July hatched in 10 to 12 days. Higher temperatures prevailing during the later period probably explains the accelerated development.

The First Stage Larva.—The newly hatched larva is about 1.5 mm. in length. The head capsule and thoracic shield are black; the body is yellowish orange; the anal segment is concolourous with the body and the anal shield appears to be absent.

After leaving the egg, the young caterpillar wanders about on the new twigs sometimes for two or three hours. It travels from needle to needle, crawling up and down as far as the edge of the sheath, rarely ascending above that point. Finally it settles in the axil of a needle bundle and proceeds to spin a characteristic silken tube between the lower part of the sheath and the stem of the shoot or the nearest bud. Most frequently, the needle selected is close to the buds, but quite often tubes are spun at a considerable distance from the latter. The tube, or tubular web is narrowest at its point of attachment to the needle and widens gradually toward the other end where it extends into a flattened gallery, the end of which is left open. Fig. 1, W shows such a tube slightly enlarged and figure 8 gives a greatly magnified view of the same. The entire tube is not more than 2 or 3 mm. in length. As soon as the web is completed the larva begins to bore its way through the sheath into the needles. There it feeds between the needles, usually consuming the inner surface but sometimes constructing short mines. The frass is pushed into the silken tube and occasionally carried by the larva, between its mandibles, to the opening at the lower end The entire first stage is thus passed in the needles and lasts from 5 to 7 days. At the end of this period the skin is cast at the place of feeding and is later pushed out into the tubular web or brought to the mouth of the opening. Cast heads were found both inside of the tubes and near the above mentioned opening. Needles attacked by the first stage larva become loosened, they gradually turn brownish, droop and often fall out of the sheath. The presence of such drooping or discoloured needles constitutes an easy means of locating infested buds and shoots, at least during the early part of the larval life. Figure 9 shows the work of a larva on a needle.

The Second Stage Larva.—The newly moulted second stage larva is about 2.5 mm. in length. The head capsule and thoracic shield are black; the body is brownish and the anal shield, which is now distinctly visible, is brown or blackish.

In this stage, the larva usually continues to feed upon the needles for a time. This time seems to vary considerable in length in different larvae. Eventually, however, the caterpillar begins to spin a second web, much larger and more cell-like than that spun in the first stage. Not a single case was found in which

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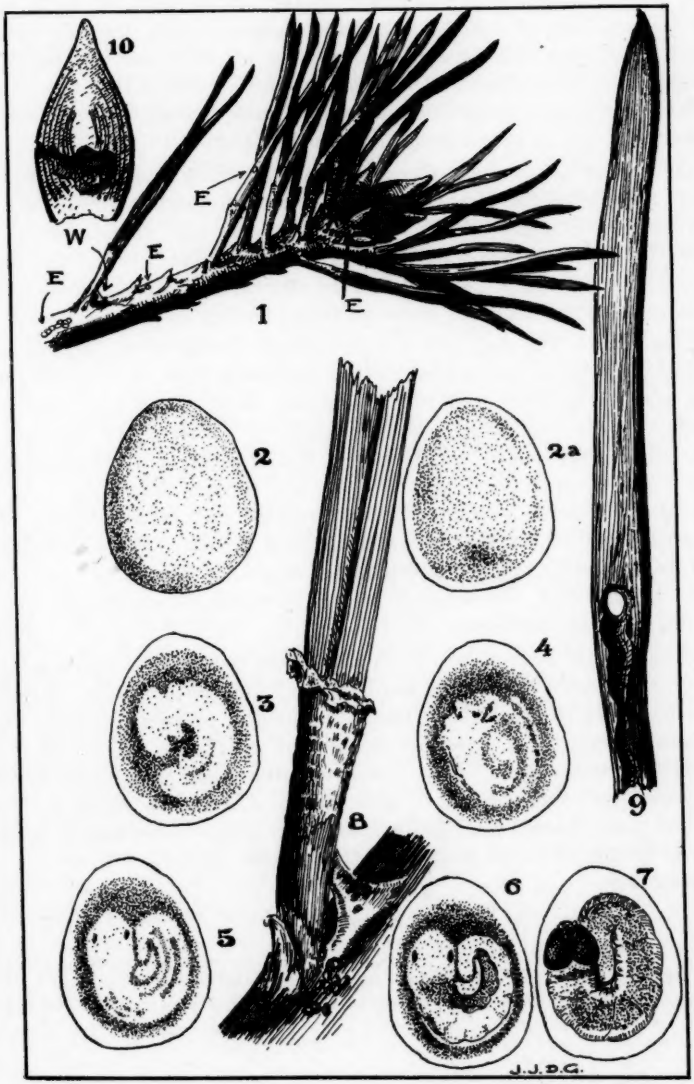

EUROPEAN PINE SHOOT MOTH.

the larva effected its entrance into the bud through the large end of the first web, although this end might be directly attached to a bud. The second web is constructed either between two or more buds or between the buds and the adjoining needles and soon becomes lightly and uniformly covered with a coating of pitch. Immediately upon completion of the second web the larva proceeds to bore into the side of a bud. When the buds are small, they are consumed in a very short time and the larva migrates to an adjoining bud in the same cluster or, more rarely, to a bud on another shoot. Whether or not, the larva shortly after entering the bud changes to third stage has not yet been accurately determined, but this is probable.

Two or more larvae are frequently found feeding upon the same cluster, but never more than one larva in one bud. Some second stage larvae kept in rearing cages were found mining the needles at the top. This type of injury was not observed in nature. At the time of the present writing, the duration of the second stage had not been definitely ascertained. Figure 10 is a section of a bud showing the effect of about 36 hours feeding by a larva.

Conclusion.—The fact that the first stage larvae of the European pine shoot moth feed upon the needles and not upon the buds, as has always been asserted, coupled with the fact that the second stage larvae beside feeding on the needles usually enter the buds at a point not protected by the first web, seems to offer some added possibilities in the application of chemical control methods. Timely treatments with contact and poison sprays or with combinations of both should give good results provided such sprays can be made to spread evenly and adhere for a sufficiently long period to the new shoots and buds. Close attention to the developmental stages of the embryo may further assist in devising effective ovicides as well as in timing sprays to be applied against the hatching caterpillars.

It was found that on heavily infested trees quite a few larvae continued to feed on the needles even in the third stage of their development. Apparently these larvae travel from needle to needle, spinning a protective web in the axil before boring through the sheath at the base of the bundle. The web is much larger than the web spun by the larva in the first stage and is entirely closed. This type of injury was particularly abundant on a large new shoot from which the bud had been removed early in the season, but it was found also on a number of other twigs on which all buds were still present and seems to be the result of overcrowding.

EXPLANATION OF PLATE

Fig. 1.—New shoot of Scotch pine with part of needles removed, showing location of eggs (E) and tubular web spun by first stage larva (W)—(slightly enlarged).

Fig. 2-7.—Various stages in the development of the embryo as seen through the egg shell.
2 —Newly laid egg.
2a—Egg, 2 days old.
3 —Egg, 7 days old.
4 —Egg, 8 days old.
5 —Egg, 9 days old.
6 —Egg, 10 days old.
7 —Egg, 11 days old.—larva completely formed (all greatly enlarged).

Fig. 8.—Tubular web spun by first stage larva in the axil of a needle bundle. Frass and cast head capsule near open end of web. (Upper part of needles not represented; greatly enlarged).

Fig. 9.—Needle of Scotch pine, showing entrance hole and usual type of feeding of first stage larva. (Greatly enlarged).

Fig. 10.—Pine bud showing the effect of 36 hours feeding by the larva after entering the bud. (Greatly enlarged).

A TAXONOMIC NOTE*

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In view of the general uncertainty in regard to the species of *Perimegatoma* Horn, the following notes may assist in the determination of the species.

Perimegatoma cylindrica Kirby.

impressa Csy. ♂ 1900. Jour. N.Y. Ent., VIII, P. 150.
monticola Csy. ♂ 1900. Jour. N.Y. Ent., VIII, P. 151.

Length 3 to 4 mm. In the course of our biological studies of *Dendroctonus* infesting yellow pine a long series of this species has been recovered in the yellow pine (*Pinus ponderosa* Laws) cages. They evidently breed in or under the bark but further information is wanting. However, of 52 specimens so recovered, 24 specimens were found to be females and 28 males. It is quite certain that these are all one species, and that the difference between the sexes constitutes the major divisions in Col. Casey's key (1900, Jour. N. Y. Ent., Vol. VIII, June, pp. 149-151) to the species. In several instances the genitalia of both sexes has been examined in order to leave no doubt in the writer's mind. The following will serve to distinguish the sexes.

Antennal club with distal segment not longer than the other two combined. . ♀
Antennal club with the distal segment much longer than the other two combined ..... ♂

In this series of 52 specimens the extremes of vestiture and colour of the elytra vary considerably, with all the intermediates. The difference in vestiture is no doubt due to denuded or partially denuded specimens. The rufous sub-basal and sub-apical irregular transverse bands may be wanting, the position being indicated only by small irregular spots of grey vestiture, or the sub-apical band only may be missing.

The terminal segment of the antennal club is to a certain degree variable in length and generally more rounded in the female than in the male which latter gradually tapers and is often more pointed.

In view of the fact that several specimens have the lateral margins of the elytra partially rufous, *P. nevadica* Csy. would also seem of doubtful specific status, and is probably a female of *cylindrica* Lec.

P. variegata Horn presents the same sexual differences in the antennae. In a series of 10 specimens before me I cannot separate *P. ampla* Csy. from *P. variegata* Horn. In some specimens, probably rubbed, the elytra vestiture is not bi-colored but the vestiture of the pronotum seems always to be rufous in colour.

*Contribution from Division of Forest Insects, Entomological Branch, Dept of Agric., Ottawa.

SOME ERYTHRONEURA (GRAPE LEAF HOPPERS) OF THE MACULATA GROUP (HOMOPTERA, CICADELLIDAE).

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CONCLUSION OF THE MACULATA GROUP OF THE GENUS ERYTHRONEURA

An effort has been made in the preceding pages to present all the species of *Erythroneura* that have been described in the Maculata Group as well as a large number of new species. The scutelleris Group is included also because it was found they could not easily be separated on the external characters as given by other writers and the genitalia showed close relation to the Maculata Group. No doubt other species will be found as more intensive collecting is done in various parts of the country. There are on hand a great many dissected specimens which seem closely related and yet distinct in some respects. It was thought best to wait for additional material before making decisions in regard to these.

KEY TO THE SPECIES OF ERYTHRONEURA IN THE MACULATA GROUP

1. Posterior point of style as long as foot or longer 2
   Posterior point of style shorter than foot 43
2. (1) Oedagus of considerable breadth in ventral or dorsal view, not just a straight tube 3
   Oedagus just a straight shaft in ventral or dorsal view 27
3. (2) Pygofer hook bifid at tip 4
   Pygofer hook not bifid at tip 11
4. (3) Color on clavus almost solid red 5
   Color on clavus not almost solid red 6
5. (4) White area inclosed in red larger; even curve between points of pygofer hook ..... *pyra* McA. (70)
   White area smaller; points of pygofer hook forming an angle ..... *aesculi* n. sp. (46)
6. (4) Posterior point very thin; oedagus more than twice as broad at base as tip ..... *linea* n. sp. (48)
   Posterior point wider; oedagus as broad as or broader at tip 7
7. (6) Tegmen conspicuous with red spots 8
   Tegmen of usual maculata group coloring 9
8. (7) Tegmen with two pairs of bright red spots ..... *bifida* n. sp. (12)
   Tegmen with bright red saddle-shaped spot ..... *aesculi* n. sp. (46)
9. (7) Pygofer hook split almost half way ..... *consueta* n. sp. (54)
   Pygofer hook with small prong or notch on inner margin 10
10. (9) Heel protruding posteriorly; toe very slender; inner prong of pygofer hook projecting in and turning posteriorly ..... *aculeata* n. sp. (108)
    Heel protruding slightly in rather than posteriorly; toe not slender; inner fork of pygofer hook usually very close to outer .... *concisa* n. sp. (28)
11. (3) Pygofer hook as wide or widest at base 12
    Pygofer hook widest some place away from base 22
12. (11) Oedagus quadrate or widest on outer half 13
    Oedagus tapering on outer half 16

13.(12) Oedagus almost quadrate in ventral view 14
Oedagus not quadrate in ventral view 15
14.(13) Posterior point wide at base; pygofer hook curved strongly out at tip ..... *clara* n. sp. (109)
Posterior point narrow at base; pygofer hook scarcely, if at all, turned out at tip ..... *dira* n. sp. (27)
15.(13) Heel small; foot almost parallel-sided; oedagus not evenly rounded at tip ..... *sancta* n. sp. (41)
Heel large; foot not parallel-sided; oedagus with round tip ..... *parallela* McA. (20)
16.(12) Posterior point very broad, almost triangular in shape ..... *triangulata* n. sp. (14)
Posterior point narrow throughout 17
17.(16) Pygofer hook bent sharply in on outer third..... *torella* Rob. (80)
Pygofer hook not so bent 18
18.(17) Some dark markings on tegmen ..... *septima* Beamer (69)
No dark markings on tegmen 19
19.(18) Oedagus tapered on outer third; tip of pygofer hook slightly turned out 20
Oedagus rather chisel-shaped at tip; pygofer hook sword-shaped, turning in ..... *penesica* n. sp. (23)
20.(19) Oedagus bent dorsally into a thin hoe-like tip..... *marra* n. sp. (107)
Oedagus not bent dorsally into a thin hoe-like tip 21
21.(20) Pygofer hook reaching to end of pygofer..... *lawsoni* Rob. (87)
Pygofer hook extending to slightly beyond middle of pygofer ..... *omani* Beamer (102)
22.(11) Conspicuous in external markings from ordinary maculata group.... 23
Not conspicuous in external markings..... 25
23.(22) With two transverse black vittae ..... *morgani* (DeL.) (86)
With red markings 24
24.(23) Basal two thirds of clavus solid red..... *bella* McA. (76)
With two red spots on each tegmen..... *rubranotata* Beamer (72)
25.(22) Oedagus heart-shaped; posterior point triangular very broad at base ..... *triangulata* n. sp. (14)
Oedagus not heart-shaped; posterior point narrow at base almost parallel-sided 26
26.(25) Posterior point not longer than foot; oedagus not parallel-sided in lateral view ..... *arta* n. sp. (30)
Posterior point longer than foot; oedagus very short and almost parallel-sided ..... *certa* n. sp. (104)
27. (2) Pygofer hook as wide or wider at base than any other place..... 28
Pygofer hook widest some place other than base 36
28.(27) Pygofer hook turns out at tip 29
Pygofer hook straight or turns in at tip 32
29.(28) Pygofer hook, long S-curved 30
Pygofer hook shorter, nearer straight 31
30.(29) Oedagus beak-like ..... *rostrata* n. sp. (24)

Oedagus not beak-like ..... *knighti* n. sp. (68)

31. (29) Pygofer hook quite short, tapering rapidly on outer half; posterior point curved in ..... *parva* n. sp. (52)
Pygofer hook as long as pygofer, almost paralled-sided; posterior point straight; tegment with dark markings ..... *septima* Beamer (69)

32. (28) Tegmen with dark lunate marks ..... *lunata* McA. (5)
Tegmen without such marks 33

33. (32) Oedagus almost parallel-sided in lateral view 34
Oedagus in lateral view twice as wide at base as tip, curved 35

34. (33) Posterior point straight; oedagus bent ventrally ..... *abjecta* n. sp (32)
Posterior point longer, curved in; oedagus not curved ventrally; heel more pronounced ..... *mirifica* n. sp. (105)

35. (33) Oedagus straight; posterior point of style curved ..... *gemina* McA. (7)
Oedagus curved; posterior point straight ..... *adunca* n. sp. (47)

36. (27) Pygofer hook long, extending beyond tip of pygofer 37
Pygofer hook short, not extending beyond tip of pygofer 40

37. (36) Oedagus in lateral view very wide 39
Oedagus narrow, about as wide as width of foot 38

38. (37) Pygofer hook bifid ..... *minor* n. sp. (61)
Pygofer hook not bifid ..... *incondita* n. sp. (42)

39. (37) Oedagus about as wide as long; tip rounded ..... *rotunda* n. sp. (31)
Oedagus at least twice as long as wide, tip rather blunt. *knighti* n. sp. (68)

40. (36) Abdomen dark; oedagus in lateral view very short and sharply bent near base ..... *nigriventer* n. sp. (11)
Abdomen light 41

41. (40) Pygofer hook bifid ..... *minor* n. sp. (61)
Pygofer hook not bifid 42

42. (41) Pygofer hook tapering and slender on outer half .... *ingrata* n. sp. (106)
Pygofer hook tapering on not more than outer third ... *usitata* n. sp. (39)

43. (1) Practically no posterior points on foot of style 44
At least some posterior points on foot of style 64

44. (43) Pygofer hook double 45
Pygofer hook single 50

45. (44) Pygofer hook divided on less than half its length ..... *unica* n. sp. (59)
Pygofer hook divided almost to base 46

46. (45) Portions of pygofer hook unequal in length 47
Portions of pygofer hook about equal in length 48

47. (46) Inner portion of pygofer hook parallel-sided on basal half; oedagus in lateral view narrow ..... *forfex* n. sp. (57)
Inner portion of pygofer hook not parallel-sided; oedagus very broad in lateral view ..... *impar* n. sp. (9)

48. (46) Parts of pygofer hook converging to almost touch at tips ..... *restricta* n. sp. (45)
Parts of pygofer hook not converging to touch at tips 49

49. (48) Inner portion of pygofer hook with S-curve; oedagus narrow ..... *curvata* n. sp. (8)
Inner portion of pygofer hook without such a curve; oedagus much

wider ..... *carmini* Beamer (96)
50.(44) Tip of oedagus with processes ..... *noncuspidis* n. sp. (3)
Tip of oedagus without processes 51
51.(50) Pygofer hook suddenly thickened at some particular spot 52
Pygofer hook almost parallel-sided throughout 57
52.(51) Pygofer hook thickened on less than one fourth its length 53
Pygofer hook thickened on more than one fourth its length 54
53.(52) Enlargement appears much as a closed human hand .... *manus* n. sp. (60)
Enlargement much smaller, tapering rapidly into an evenly curved sharp tip ..... *ungulata* n. sp. (51)
54.(52) Oedagus in lateral view quite slender; pygofer hook greatly enlarged on outer two thirds 55
Oedagus in lateral view much wider; pygofer hook enlargement not occupying outer two thirds 56
55.(54) Pygofer hook more than twice as wide, at widest place, as at its narrowest point near base ..... *immota* n. sp. (43)
Pygofer hook not twice as wide, at widest place as at its narrowest point near base ..... *era* McA. (84)
56.(54) Enlargement at middle or before; oedagus usually straight ..... *propria* n. sp. (36)
Enlargement usually beyond middle; oedagus in lateral view bent ..... *brevipes* n. sp. (10)
57.(51) Pygofer hook curved in 58
Pygofer hook with S-curve 59
58.(57) General color milky white with delicate pink markings; oedagus in lateral view narrow ..... *stephensoni* n. sp. (4)
General color not milky white; oedagus very wide in lateral view ..... *clavipes* n. sp. (22)
59.(57) Inner portion of S-curve deep and somewhat flattened 60
Inner portion of S-curve not so deep, round 61
60.(59) Toe very long and slender; oedagus broad in ventral view ..... *calamitosa* n. sp. (16)
Toe broader than foot just before it; oedagus narrow in ventral view ..... *opulenta* n. sp. (49)
61.(59) Inner portion of S-curve shallow and nearer straight 62
Inner portion of S-curve deeper, evenly rounded 63
62.(61) Small red cross-band on middle of tegmen ..... *era* McA. (84)
No red cross-band ..... *lenta* n. sp. (58)
63.(61) Oedagus in lateral view short, very heavy at base, tip much flattened, projecting dorsally in a thin lip ..... *retusa* n. sp. (50)
Oedagus in lateral view slender, slightly tapering, tip rounded ..... *parvipes* n. sp. (18)
64.(43) Posterior point of style more than half as long as foot 65
Posterior point of style less than half as long as foot 78
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Oedagus narrow in ventral view 71
66.(65) Oedagus with processes at tip or pygofer hook bifid 67

Oedagus without processes and pygofer hook not bifid.....68
67.(66) Pygofer hook bifid .....*californica* n. name (101)
Pygofer hook not bifid; oedagus with processes at tip .....*maculata* (Gill.) (1)
68.(66) Oedagus widest at tip 69
Oedagus widest near base 70
69.(68) Posterior point almost as long as foot.....*sancta* n. sp. (41)
Posterior point scarcely half as long as foot .....*lata* n. sp. (67)
70.(68) Pygofer hook narrowed abruptly on outer third to less than half its width .....*contracta* n. sp. (6)
Pygofer hook not so narrowed .....*arta* n. sp. (30)
71.(65) Pygofer hook curved in 72
Pygofer hook curved out 75
72.(71) Oedagus very short; foot of style narrow.....*curta* n. sp. (66)
Oedagus about as long as foot; foot not twice as long as wide .....*ligata* McA. and its varieties 73
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Anterior half of clavus and two vittae on middle of pronotum dusky to black .....*ligata* var. *pupillata* McA. (88)
74.(73) Head and pronotum with faint yellow markings; tip of clavus not marked .....*ligata* var. *ligata* McA. (88)
Head and pronotum with red markings; tip of clavus with red spot .....*ligata* var. *allecta* McA. (88)
75.(71) Pygofer hook with deep cut curve .....*teres* n. sp. (21)
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76.(75) Pygofer hook tapering from base to tip.....77
Pygofer hook thickened in middle .....*uncinata* n. sp. (17)
77.(76) Foot long, quite slender; posterior point more than twice as long as wide .....*macra* n. sp. (40)
Foot short, stouter; posterior point about twice as long as width at base .....*solita* n. sp. (38)
78.(64) Oedagus with processes on shaft or at its base 79
Oedagus without such processes 88
79.(78) Processes on tip of oedagus 80
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80.(79) A second pair of processes near middle of shaft.....*gillettei* n. sp. (2)
Without second pair of processes .....*noncuspidis* n. sp. (3)
81.(79) Pygofer hook with band of hair 82
Pygofer hook without band of hair 83
82.(81) Processes almost as long as shaft of oedagus; oedagus in lateral view almost straight not very wide.....*andersoni* n. sp. (65)
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84.(83) Pygofer hook short and swollen.....*osborni* and varieties 85
Pygofer hook not swollen .....*illinoiensis* and varieties 86

85.(84) Cross-band on tegmen brilliant red.....*osborni* (DeL.) (74)
Cross-band varying from almost white to pink .....*osborni* var. *dulcis* McA. (74)
86.(84) External markings black spots only....*illinoiensis* var. *spectra* McA. (91)
Some red dots present also 87
87.(86) Black spots near costal plaque elongate; specimens larger .....*illinoiensis* var. *regalis* Beamer (91)
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Pygofer hook not bifid 98
89.(88) Oedagus widened in ventral view 90
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Pygofer hook not split over one third distance to base 91
91.(90) Scutellum and sometimes pronotum and head smoky black.....92
Scutellum pronotum and head chiefly red..*kansana* var. *ardens* McA. (81)
92.(91) General markings of body pink or red....*kansana* var. *kansana* Bk. (81)
General markings of body absent.....*kansana* var. *insolita* McA. (81)
93.(89) Pygofer hook with two short spines of about equal length .....*bispinosa* n. sp. (15)
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94.(93) Spines of pygofer hook unequal in length.....95
Spines of pygofer hook about equal, one forth as long as shaft.....97
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Inner spine less than half as wide and not much more than half as long as outer .....*facota* n. sp. (53)
96.(95) Pygofer hook wide on more than half its length; inner hook at about right angles to shaft .....*incpta* n. sp. (110)
Pygofer hook not wide; inner hook not at right angles to shaft .....*unica* n. sp. (59)
97.(94) Outer edge of pygofer hook much heavier; inner edge apparently a thin sheet .....*firma* n. sp. (35)
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Pygofer hook not radically curved 106
99.(98) Pygofer hook swollen someplace on inner half to twice size at base .....*turgida* n. sp. (19)
Pygofer hook not as above 100
100. (99) Pygofer hook with S-curve .....*bigemina* McA. 100
Pygofer hook radically bent one way or other.....101
101.(100) Pygofer hook curved out 102
Pygofer hook curved in 105
102.(101) Oedagus semicircular or with spiny tip 103
Oedagus not as above 104
103.(102) Oedagus semicircular in lateral view .....*ballista* n. sp. (62)

Oedagus straight with spiny tip ..... *spinifera* n. sp. (13)

104. (102) Pygofer hook heavy especially at base; most markings of tegmen appear to be fading out ..... *hymac* Rob. (95)

Pygofer hook much more fragile; bright red spots on vertex, scutellum and clavi much larger ..... *externa* n. sp. (33)

105. (101) Oedagus with spine ventrad to base of shaft..... *texana* Beamer (79)

Oedagus without such a spine ..... *interna* n. sp. (26)

106. (98) Abdomen dark 107

Abdomen light 110

107. (106) General color of dorsum milky-white with delicate markings ..... *stephensoni* n. sp. (4)

Not as above 108

108. (107) Pygofer hook long and narrow with S-curve; anterior half of tegmen usually dark ..... *basilaris* (Say) (98)

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Oedagus not broad in ventral view ..... *affinis* Fitch. (99)

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Pygofer hook curved out 117

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Oedagus in lateral view not bent dorsally into lip at tip 113

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Tegmen not so colored; oedagus in lateral view broad and beak-shaped ..... *penerostrata* n. sp. (63)

113. (111) Dorsum with three black cross-bands ..... *trivittata* Rob. (78)

Dorsum without such bands 114

114. (113) Posterior point of foot as long as toe is wide; slender..... 115

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Markings orange 116

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117. (110) Pygofer hook distinctly swollen on outer portion or if near base at least twice as wide as at base 118

Pygofer hook not as above 121

118. (117) Swollen area of pygofer on tip and not occupying more than one fourth length 119

Swollen area of pygofer hook occupying more than one fourth its length 120

119. (118) Posterior point of style very short and sharp, scarcely projecting beyond base of foot; oedagus in lateral view short, stout and bent at base ..... *mensa* n. sp. (29)

Posterior point as long as toe is wide; oedagus in lateral view slightly longer, almost straight and not so wide .....*dumosa* n. sp. (37)

120.(118) Enlargement of pygofer hook on anterior half ....*turgida* n. sp. (19)
Enlargement of pygofer hook on outer half .....*tantilla* n. sp. (25)

121.(117) Pygofer hook with distinct S-curve or both points of foot as long as toe is wide, sharp 122
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122.(121) Pygofer hook slender; points short 123
Pygofer hook thicker; points of foot long and sharp .....*confirmata* McA. (71)

123.(122) Tip of anchor spot on clavi so enlarged as to appear as a narrow cross-band .....*univittata* Rob. (77)
Tip of anchor mark normal .....*bigemina* McA. (100)

124.(121) Base of oedagus usually appearing as a spine in lateral view; pygofer hook tapering from base to sharp out curved tip ....*solita* n. sp. (38)
Base of oedagus without spine; basal half of pygofer hook much wider than outer .....*rubraza* Rob. (85)

HOST RECORDS AND NEW SPECIES OF CANADIAN HYMENOPTERA*

BY G. STUART WALLEY,
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The following notes are based on material in the Canadian National Collection at Ottawa. A large proportion of the reared material was obtained by Dr. J. McDunnough at Bobcaygeon, Ont. in the course of his studies on the Lepidoptera of that region. His rearings of several species of *Haploptilia* yielded a number of parasites the habits of which have heretofore been little known in Canada. Other material mentioned below was reared by the writer and by various economic officers of the Entomological Branch staff. The determinations of the lepidopterous hosts of the Bobcaygeon material are by Dr. McDunnough.

ICHNEUMONIDAE

Phaeogenes hebrus (Cress.)

P. hebrus (Cresson) Trans. Am. Ent. Soc. I, 305, 1867.

A female from Bobcaygeon, July 5, 1931 (J. McDunnough) reared from *Exartema cornanum* Heinr. answers very well to Cresson's description. I associate with this two males (Bobcaygeon, July 3, 1931) one of which was reared from *E. cornanum;* the other is from an unidentified lepidopterous larva from *Cornus*. The males have the antennae pale brownish above and yellowish brown below without an annulus.

Hemiteles tenellus (Say)

H. tenellus (Say) Boston Jl. Nat. Hist. I. 233, 1836.

Two large and four small females of this species are at hand. The larger specimens measure 4.5 mm. in length. Of these one emerged from what is probably the case of *Haploptilia tiliaefoliella* Clem. at Bobcaygeon, June 25, 1931 (J. McDunnough). The primary parasite of the *Haploptilia* is

*Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

not known. The other large specimen of *tenellus* was reared from a Campoplegine pupal case attached to an *Olene* larval skin. The *Olene* larva was found on European Larch (*Larix decidua* Mill.) in the grounds of the Experimental Farm at Ottawa.

Four small females of *tenellus* were reared from cases of *Haploptilia innotabilis* Brn. at Bobcaygeon, July 5-11, 1931 (J. McDunnough). These measure slightly less than 3 mm. Their host is not known but may be *Microbracon pygmaeus* (Prov.) which was reared from *Haploptilia innotabilis* at Bobcaygeon. They are very similar in color, sculpture and wing pattern to the above two larger examples. The difference in size possibly may be owing to a difference in host. The small specimens have the post-petiole a little less abruptly broadened and three have the flagellum 19 segmented, the fourth 20 segmented. The larger specimens have 21 segments which is apparently the usual number for *tenellus*.

Campoplex fugitivus (Say)

C. fugitivus (Say) Boston Jl. Nat. Hist. I, 247, 1836.

A single male is at hand, reared from an unidentified lepidopterous larva which was feeding in a terminal leaf cluster of Sweet Fern (*Comptonia*) at Kazubazua, Que. The parasite emerged at Ottawa, Sept. 8, 1931 (Walley).

Campoplex (Angitia) antennaellae n. sp.

Female—Length 3.5 mm.; ovipositor .70 mm. Head black, face finely granular with short pale yellow pubescence. Antennae black, scape and pedicel dirty yellowish below. Mandibles yellow, brown tipped; palpi whitish. Malar space distinctly narrower than basal width of mandible. Ocellocular line slightly greater than greatest diameter of lateral ocellus and slightly less than distance between lateral ocelli.

Thorax black, tegulae yellow, dorsum finely granular, dullish in front more shining posteriorly and on scutellum. Mesopleura almost wholly finely obliquely rugulose and shining. Metathorax with sides rugose-punctate; spiracle small, circular; areola and petiolarea confluent, the latter transversely rugulose.

Front coxae reddish at base, yellowish toward apex; middle coxae reddish brown; hind coxae black. All trochanters yellow. All femora and four anterior tibiae and tarsi reddish brown. Hind tibiae with brownish sub-basal and apical bands connected ventrally with a brownish streak, extreme base and median portion pale yellowish. Hind tarsi brownish except base of the first segment which is somewhat paler.

Areolet small, oblique, petiolate; recurrent vein received distinctly beyond middle of areolet. Stigma narrow, wholly brown.

Abdomen black. First segment short, with lateral grooves on petiole and slight impressions before apex of post petiole. Petiole smooth at base, post-petiole and following tergites finely sculptured and with short appressed yellowish hairs.

Male.—Length 3.5 mm. General color similar to female, face with denser pale pubescence, scape almost wholly yellowish, middle coxae wholly stramineous, hind trochanters dusky above, hind femora darker reddish brown with dusky suffusion dorsally, dirty yellowish annulus of hind tibia complete. Wings without areolet.

Holotype—♀, Bobcaygeon, Ont., late July, 1931, (J. McDunnough); No. 3385 in the Canadian National Collection, Ottawa, Ont.

Allotype—♂, same data as holotype.

Paratypes—3 ♂♂, same data as holotype.

Host—All specimens emerged from cases of *Haploptilia albiantennaella* Wild.

Notes—The above species resembles *A. basizona* Vier. and traces to section 3 in my key (Can. Ent. LXI, 192, 1929). The males lacking an areolet will not trace to *Angitia* in Viereck's arrangement(Can. Ent. LVII, 201, 1925). *Basizona* Vier. is known only from the male type from Victoria, B. C. My series of males compared with the type of *basizona* differ in having the wing without an areolet, the spiracles of the first abdominal segment not elevated as in *basizona* and the scape of the antenna largely yellow.

Cremastus epagoges Cush.

C. epagoges Cushman. Proc. U. S. N. M., LIII, 531, 1917.

Two females are at hand, reared on July 4, and 8, 1931 by Dr. McDunnough at Bobcaygeon, Ont., from a case bearer on *Monarda fistulosa*. I can find no tangible characters either in structure or color to separate them from *epagoges* as described by Cushman and for the present I place them as this. One of my specimens has the yellow orbits interrupted on the genae and the other has the hind coxae, trochanters and femora entirely reddish. The paler thoracic markings are reduced in both specimens.

Triclistus curvator (Fabr.)

I. curvator (Fabricius) Ent. Syst. II, 177. 1793.

One specimen was reared from *Exartema exacresimum* Heinr. at Point Pelee, Ont., July 16, 1927, by Mr. F. P. Ide.

Exochus pallipes Cress.

E. pallipes Cress. Proc. Ent. Soc. Phila., III, 287. 1864.

Two examples were reared by Dr. McDunnough at Bobcaygeon. One emerged July 3, 1931 from a microlepidopteron, the larva of which was found feeding on *Ostrya*. The other emerged July 7, 1931 from a microlepidopteron the larva of which fed on Hickory. I have also at hand a single specimen from Aylmer, Que., July 2, 1919 (J. McDunnough) reared from a species of *Acrobasis* on *Ostrya*.

Epiurus investigator (Wlsh.)

E. investigator (Walsh) Tr. St. Louis Acad. III, 142, 1873.

A female was reared from an unidentified microlepidopterous larva feeding on *Cornus* at Bobcaygeon, June 29, 1931 (J. McDunnough).

Phytodietus burgessii Cress.

P. burgessii Cress. Tr. Am. Ent. Soc. II. 105, 1868.

One female was reared from an unidentified Eucosmid larva feeding on *Myrica*, at Bobcaygeon, July 3, 1931, by Dr. McDunnough. The cocoon of the parasite is a very delicate, shining, whitish translucent, elongate, cylindrical structure, 9 mm. long with a narrow, median, opaque, whitish annulus.

BRACONIDAE

Macrocentrus exartemae n. sp.

Female—Length 4 mm.; sheath of ovipositor 5 mm. Head transverse, in frontal aspect distinctly broader than high, vertex distinctly elevated above level of eyes. Clypeus elevated, its free margin very feebly emarginate. Malar

space approximately one and one-half times basal width of mandibles. Surface of head smooth, shining with a few sparse setigerous punctures most numerous on front above clypeus. Front with a few faint oblique wrinkles below antenae. Maxillary palpi long, fully as long as front tibia, basal joint scarcely half as long as second joint, second and third joints subequal, fourth joint about three-fourths as long as third, apical joint very slightly longer than fourth. Postocellar line almost one and one-half times lateral ocellar line and about two-thirds ocellar line. Flagellum of 45 joints, first joint one-third longer than second, eight times as long as diameter at middle; subapical joints three times as long as thick. Mesonotum polished almost impunctate, scutellum shining with sparse setigerous punctures. Pleura shining, sparsely punctate, the punctures denser along sternauli than above. Propodeum rugose, finely at base becoming more strongly so toward apex. Legs slender, all trochanters with teeth, front basi-tarsi slightly longer than following three segments.

First abdominal segment two and two-thirds as long as width at apex, basal width three-fourths that at apex. Second segment three-fourths as long as first, third segment one-half length of first. First three tergites longitudinally striate throughout. Fourth tergite finely sculptured at base, abdomen smooth beyond.

Stigma three times as long as broad; radial vein arising just before apical third. First abcissa of radius one-third as long as the second and equal to second transverse cubitus.

Color black. Head shining black, margin of clypeus, mandibles, palpi and gular region stramineous. Scape and pedicel yellowish stramineous, tinged with a brownish spot above. Flagellum black. Entire ventral region of pro- and mesothorax and lower third of mesopleura, stramineous. Legs yellowish stramineous, all tarsi becoming dusky towards apices, hind femora with apices broadly brownish except below, hind tibia brownish except for narrow pale bases. Abdominal tergites shining black except for stramineous apical angles and narrow apical margin of third. Membranous ventral segments of abdomen stramineous. Sheath of ovipositor blackish. Stigma blackish, veins brown, wings faintly tinged with brown.

Holotype—♀, Bobcaygeon, Ont., July 3, 1931, (J. McDunnough); No. 3386 in the Canadian National Collection, Ottawa, Ont.

Paratypes—10 ♀ ♀, same data as holotype.

Host—All specimens reared from larvae of *Exartema cornanum* Heinr.

Notes—Resembles *nigridorsis* Vier. but easily separated on the color of the thorax which in *nigridorsis* is black below. From *harrisi* De Gant it may be distinguished by the shorter ovipositor and the color of the thorax and hind femora.

Bassus cinctus (Cress.)

B. cinctus (Cresson) Can. Ent. V, 53, 1873.

One female was reared July 31, 1931 by Dr. McDunnough from *Haploptilia alniella* Heinr. taken at Bobcaygeon. The specimen traces readily to *cinctus* in Muesebeck's key (Proc. U. S. N. M., LXIX, Art. 16, p. 30, 1927). The hind coxae and the entire second and third abdominal tergites are wholly ferruginous. The second tergite is entirely coriaceous and the third bears faint traces of sculpturing.

Bassus annulipes (Cress.)

B. annulipes (Cresson) Can. Ent. V, 53, 1873.

Two males were reared by Dr. McDunnough at Bobcaygeon. One emerged, June 20, 1931 from an unidentified microlepidopterous larva on *Ostrya*, the other June 21, 1931 from another unidentified microlepidopterous larva on *Cornus*. A male is also at hand from Severn, Ont. July 17, 1925 (J. McDunnough) reared from *Haploptilia* sp. (? *comptoniella* McD.).

Apanteles aristoteliae Vier.

A. aristoteliae Viereck. Proc. U. S. N. M., XLII, 613, 1912.

One female was reared by the writer from an unidentified microlepidopterous larva in a head of Sweet Fern (*Comptonia*) from Kazubazua, Que., Sept. 1931. The recorded hosts for *aristoteliae* are *Aristotelia fungivorella* Clem., *Gelechia trialbamaculella* Chamb., *Gelechia confusella* Chamb. and *Gelechia* sp. *Gelechia trialbamaculella* is known from Kazubazua as is also an undetermined *Gelechia* species which was reared from larvae feeding on Sweet Fern.

The parasite emerged from an ovate-cylindrical cocoon 4 mm. long, composed of pure white silk.

Microplitis carteri n. sp.

Male.—Length 3 mm. Face, vertex, temples and genae closely confluently punctate and dull. Clypeus more shallowly punctate, rather shining. Antenna 4.5 mm. Mesoscutum opaque, closely punctate; except for a narrow transverse polished line along the posterior margin, parapsidal grooves faintly indicated. Scutellum noticeably longer than broad, dull, with shallow confluent punctures. Mesopleura rugulose-punctate before and below the crenulate furrow, a shining impunctate, polished area behind. Propodeum coarsely rugose-reticulate with a median longitudinal carina. Plate of first abdominal tergite about three times as long as basal width, broadest just behind middle, apex slightly narrower than base, finely rugulose throughout except for a small apical polished elevation. Membranous margins of first tergite almost as broad as plate. Second tergite and beyond polished, impunctate; narrow side margins and anterior angles of second tergite semi-membranous, merging gradually with the more heavily chitinized transverse region. Stigma fully two and one-half times as long as broad, slightly longer than metacarpus.

Color black; scape, pedicel, labrum, mandibles, tegulae, legs including all coxae, reddish testaceous. Flagellum dark reddish brown. Tips of tarsi brownish. Membranous sides of first abdominal tergite obscurely castaneous. Basal third of abdomen below and palpi yellowish testaceous. Stigma brownish with almost the basal half yellowish; membrane tinged with brownish.

Holotype—♂, Brooks, Alta., June 8, 1923, (Walter Carter); No. 3387 in the Canadian National Collection, Ottawa, Ont.

Paratypes—2 ♂♂, Alberta.

Notes—Traces to *laticinctus* Mues. in Muesebeck's key (Proc. U. S. N. M. LXI, 46, 1922) but easily distinguished by the absence of the broad testaceous abdominal band.

Microgaster canadensis Mues.

M. canadensis Muesebeck. Proc. U. S. N. M., LXI, 38, 1922.

One male from Bobcaygeon, June 27, 1931, reared by Dr. McDunnough from *Argyrotoxa albicomana* Clem. traces to *canadensis* in Muesebeck's paper (op. cit.) and appears to answer very well to the description of that species except that the rugulose face is somewhat shining and the posterior tibiae and tarsi are only faintly dusky. These appear to be only trivial differences however and possibly quite within the range of variation for *canadensis*.

Microgaster gelechiae trichotapheae n. var.

Male—Length 4 mm. Resembles *gelechiae* Riley but differs slightly in color and puncturation. Compared with a male of *gelechiae* (Trenton, Ont.) the face is a little narrower in proportion to its height, the mesonotum is more heavily punctate especially in front, the coxae are testaceous except the hind pair which are narrowly black at base, the hind femora have a brownish spot at the apex above, the hind tibiae are brownish especially apically and the hind tarsi are brownish throughout.

Holotype—♂, Bobcaygeon, Ont., June 27, 1931 (J. McDunnough); No. 3388 in the Canadian National Collection, Ottawa, Ont.

Host—Reared from *Trichotaphe levisella* Fyles.

Notes—This is possibly a distinct species but until further specimens including the female are obtainable I place it as a variety of the species it apparently most closely resembles.

Microbracon pygmaeus (Prov.)

M. pygmaeus (Prov.) Nat. Can., XII, 144, 1880.

Two specimens of this species are at hand, both females. One specimen emerged from the case of *Haploptilia pruniella* Clem. at Bobcaygeon, Ont., June 17, 1931 (J. McDunnough) the second from *Haploptilia innotabilis* Brn. at Bobcaygeon, July 1, 1931 (J. McDunnough). My examples agree well in structure with Muesebeck's characterization of the species (Proc. U. S. N. M. LXVII, Art. 8, p. 38, 1925). They have the coxae testaceous and the abdomen reddish testaceous with the plate of the first tergite and a median spot on tergites 3, 4 and 5 blackish. The specimen from *pruniella* measures 3 mm., that from *innotabilis* 2.5 mm. According to Muesebeck (1925) the species is widely distributed in America and has been reared from a variety of case bearers.

Microbracon melanaspis (Ashm.)

M. melanaspis (Ashm.) Can. Ent., XXIII, 1, 1891.

Six males and one female were reared from cases of *Haploptilia alniella* Heinr., on alder, at Bobcaygeon, Ont., June 21-29, 1931 (J. McDunnough). The host has been previously unknown and the species known only from the female type from Ottawa, Ont. and a female from S. W. Harbor, Maine (Muesebeck, 1925.) My female agrees well with Muesebeck's description of the type. The legs including coxae are stramineous with the apices of the hind femora and the entire hind tibia brownish.

Microbracon bembeciae n. sp.

Resembles *pini* Mues. but with stouter antennae. Apparently closely allied to *sesiae* Mues. but differing in number of antennal segments, form of second cubital cell, length of ovipositor sheath, color of face, coxae, hind femora and tibiae.

Female—Length 2.75 mm. Head very thick antero-posteriorly at insertion of antennae. Eyes in lateral aspect broadly oval. Transverse diameter of mouth opening distinctly greater than distance from the opening to the eyes. Malar space equal to second joint of antennal flagellum. Face above and below antennae very finely reticulately sculptured. Ocell-ocular line about four times diameter of ocellus. Antennae with flagellum 25 segmented, segments near base two-thirds as broad as long, none of segments as broad as long. Thorax smooth and polished, parapsidal furrows sparsely haired. Propodeum smooth and polished with a short apical stub of a median longitudinal carina preceded by a few short median transverse rugae. Stigma three times as long as broad with radius arising slightly before middle. Radius not attaining apex of wing. Second abcissa of radius fully twice as long as first. Second cubital cell more elongate than in *sesiae* with first transverse cubitus more acutely angulate with cubital vein. Plate of first abdominal tergite with large anterior depression, lateral margins and apical third strongly sculptured. Second tergite transverse, posterior margin entire, surface throughout finely rugose but shining. Third tergite faintly sculptured at base, shining throughout. Following tergites smooth and shining. Sheath of ovipositor about one-third longer than abdomen.

Head black with face below antennae, orbits above, genae, mandibles and basal incisure of first flagellar segment, yellowish ferruginous. Face with a brownish spot below antennae. Thorax shining black, anterior angles of scutum and parapsidal furrows in front of scutellum, castaneous. Tegulae stramineous. Scutellum and metanotum shining black. Palpi and legs ferruginous, hind coxae castaneous at base. Last segment of front tarsi, entire middle and hind tarsi and apical half of hind tibia brownish. Abdomen black, second tergite and base of third, yellowish ferruginous. Sheath of ovipositor black. Costa and stigma blackish brown, veins brown, wing tinged with brownish especially near middle.

Holotype—♀, Agassiz, B. C., Aug. 7, 1922, (R. Glendenning); No. 3389 in the Canadian National Collection, Ottawa, Ont.

Paratypes—4 ♀♀, same data as holotype.

Host—*Bembecia marginata* Harr.

Eubadizon ?pleuralis Cress.

E. pleuralis Cresson. Can. Ent., IV, 230, 1872.

A female from Bobcaygeon, July 1, 1931 (J. McDunnough) reared from *Epinotia lindana* Fern. on *Cornus* agrees fairly well with Cresson's diagnosis of *pleuralis*. I have also at hand female specimens from Trenton, Ont., June 12, 1901, taken at light (Evans), Covey Hill, Que., June 25, 1927. (Walley) and Knowlton, Que., July 6, 1927, (Walley). These have the thorax honey yellow except for brownish propleura and the blackish dorsum of the metathorax.

CALLIMOMIDAE

Megastigmus specularis n. sp.

Female—Length 3 mm.; abdomen 1.5 mm.; ovipositor 3 mm.

Face below antennae dullish with fine oblique rugae; more heavily rugose obliquely between antennae and ocelli; vertex with numerous fine transverse rugae, posterior orbits smooth, polished. Pronotum except narrow hind margin irregularly transversely rugulose, shining, with scattered rather large shallow

punctures. Mesoscutum shining, finely obliquely rugulose in front, a little more coarsely transversely rugulose beyond the middle. Scapulae, axillae and scutellum shining with more obscure rugae. Propodeum, rugose without median carinae, with a few long pale yellowish hairs on either side before bases of coxae. Abdomen highly polished. Stigmal vein as long as width of club; stigmal club resembling *lasiocarpae* Crosby.

Face up to middle of eyes, entire orbits except for a short space on inner margins above antennae, cheeks, mouth parts except tips of mandibles, scape and pedicel below, sides of prothorax, a spot on either side at base of pronotum, a spot on outer angle of scapula, tegulae, yellow; remainder of head and dorsum of thorax black. Meso-and meta-pleura and sternum dark brownish. Flagellum of antenna dark brownish above, yellowish brown below. Front legs yellow, middle and hind legs pale yellowish brown except hind coxae which are black. First abdominal segment almost black above, remainder of abdomen castaneous shading to yellowish brown laterally with the second and third tergites banded with brownish toward base. Sheath of ovipositor black. Wings hyaline; stigmal club not surrounded by a cloud.

Male.—Length 2.5 mm. Sculpture of head and thorax as in the female. Yellow markings slightly more extensive. Yellow orbits only very narrowly interrupted with brown; lateral spots on pronotum larger and separated only by a narrow brownish line from the yellow pleural areas; mesopleura and mesosternum yellow; hind coxae yellow; only the dorsal portion of abdominal segments black, laterally and ventrally wholly yellowish brown.

Holotype—♀, New Brunswick, March 19, 1928 (E. B. Watson); No. 3390 in the Canadian National Collection, Ottawa, Ont.

Allotype—♂, New Brunswick, Apr. 2, 1928 (E. B. Watson).

Paratypes—20 ♂♂, 54 ♀♀, New Brunswick, Mar. 16-Apr. 2, 1928 (E. B. Watson); ♂, ♀, St. Peters, N. S., May 18, 19, 1931 (M. L. Prebble) Exp. Nos. 11903-32, 11903-39.

Host.—The entire type series was reared from the seeds of *Abies balsamea.*

Notes—In Crosby's key (Ann. Ent. Soc. Am. VI, 156, 1913) this species traces to *M. tsugae* Crosby from which it may be distinguished by the longer ovipositor, the absence of bands on the middle and hind tibia and the form of the stigmal club in the female.

In general the yellowish markings of the male are brighter than in the female. In a few females the prothoracic spots are obscure or absent and the scapular spots may be dark brownish. The abdomen varies somewhat in color apparently depending on the maturity of the specimen. In rather immature examples the yellow may predominate the brownish being reduced to broad dorsal bands.

For the variety recently described as *Megastigmus spermotrophus canadensis* by Hoffmeyer (Ent. Medd., XVII, 218, 1930) I propose the new name MEGASTIGMUS SPERMOTROPHUS HOFFMEYERI, the varietal name *canadensis* having been used by Ashmead (Trans. Am. Ent. Soc. XIV, 186, 1887) for a species of Chalcid which he erroneously described as a *Megastigmus.*

Megastigmus spermotrophus Wachtl.

M. spermotrophus Wachtl. Wien Ent. Zeit., XII, 24, 1893.

A single female example of this species was taken by the writer at Covey Hill, Que., June 30, 1927.

STUDIES IN THE LIFE HISTORY OF *TRACHYKELE BLONDELI* MARSEUL.

BY GEO. R. HOPPING,
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In connection with studies on the biology of *T. blondeli,* conducted in the years 1926 to 1930 inclusive, at Pender Harbour, British Columbia, red cedar trees were inclosed in cheese-cloth cages with a view to determining the duration of the larval stage. The cages were constructed prior to April 30, 1926, and the emergence of bettles from the trees was recorded.

The first cage inclosed a western red cedar, *Thuja plicata* Don., 69 feet long, D. B. H. 14 inches. The cage length was 18 feet, width 5 feet 6 inches, height 5 feet 8 inches. The exposure was south overlooking a small lake and the elevation was less than 200 feet. The tree was felled and cut into 15 foot lengths which were piled, allowing room to move about the material after caging. The limbs were placed on top of the pile.

The second cage inclosed two small western red cedars, one with a length of 30 feet, D. B. H. 8 inches, and one with a length of 23.5 feet, D. B. H. 10 inches. The cage length was 15 feet 9 inches, width 6 feet 9 inches, height 5 feet 9 inches. The trees were piled as in cage 1, the exposure and elevation being approximately the same.

Prior to cutting, these three trees appeared to be as healthy as any growing under similar conditions in this region, and the great number of Trachykele galleries which they contained would not have been suspected from external appearances.

The third cage enclosed the crown of a standing western red cedar. The total height of the tree was 41.5 feet, D. B. H. 14 inches. The cage was 5½ feet by 5½ feet by 16 feet high. The top of the tree, a dead spike 12 feet long, was removed. The bottom of the cage was 13 feet above the ground and was provided with a trap door. The tree stood on a flat near the shore of the lake mentioned above.

The emergence of adults from these three cages over a period of five years was as follows:

In cage one, 1 adult emerged on June 5, 1926, none in 1927, 1 on May 17 and 1 on May 20, 1928, none in 1929, and 1 on June 6, 1930, a total of 4 in the period of five years.

In cage two, 1 emerged on May 19, 1926, 1 on May 24, 1927, 1 on May 14, 1928, 1 on May 16 and 1 on May 17, 1929, none in 1930, a total of 5 in the period of five years.

In cage three, 1 emerged on May 12, 2 on May 17, 1926, 1 on May 21 and 1 on May 31, 1927, 10 between May 13 and June 18, 1928, and 1 on June 2, 1929, a total of 16 in a five year period.

Inasmuch as these trees were in cages every year during the emergence and egg laying periods, and inasmuch as they were carefully examined for

adults every day, before, during and after these periods, with the exception of a few cold, rainy days, it seems improbable that any egg laying could have taken place subsequent to caging.

Life history studies have indicated (Hopping, 1927) that *T. blondeli* oviposits only on living trees. It is therefore quite certain that no eggs were deposited in the first two cages. There is a chance that oviposition may have occurred in the third experiment, on the trunk below the cage; but here again, life history studies have indicated that eggs are not deposited below the crown, except possibly in the edge of scars. Apparently the egg must be deposited near the growing tissue of the tree and the best opportunity for this is on the limbs where the bark is thin.

Granting that no eggs were laid in the cages, it then becomes apparent that the eggs producing these adults must have been deposited at least as far back as the spring of 1925. In the case of the three adults which emerged in 1929, it must have taken at least four years from oviposition to emergence, and five years in the case of the lone 1930 specimen which may have been a hold-over.

We know that the incubation and pupal periods together occupy about one month, and that after the pupae transform in the fall, the adults remain in the pupal cells until the following spring, nine months (Hopping, 1927, Burke, 1928). Subtracting these ten months leaves a larval period of at least three years and two months for the 1929 specimens.

Although this result may seem somewhat uncertain, the extreme difficulty of determining this part of the life history of *T. blondeli* must be apparent when it is considered that only living trees are attacked. It is also probable that the length of larval period varies to some extent.

NATURAL ENEMIES

Dr. Burke says (1928, p. 13): "Since the larval work is very common while the adult insect is so rare, it would seem there must be something that is very destructive to it in the later stage of development." He mentions the *Trogositid* beetle, *Temnochila chloridia* Mann., as probably preying on *T. blondeli* larvae.

Although Trachykele adults are fairly plentiful in the tree tops during mating and oviposition, they are not so numerous as the numbers of larvae in the trees would indicate. This is probably due in some measure to the hymenopterous parasite, *Odontaulacus editus* Cresson.

The writer has traced a number of *Trachykele* galleries which ended in an empty pupal cell from which a round hole about 3 millimeters in diameter led to the exterior. Several dead and dilapidated specimens of *O. editus* were found in Trachykele pupal cells and one dead specimen in fair shape. In 1928, two living specimens of this species were taken in the third cage. The identification was kindly made at the U. S. National Museum.

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NEW ARCTIC COLEOPTERA

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Bembidion bryanti n. sp.

Length, 5.5 mm. Oblong, elongate for the group, and parallel, with rounded humeri; much depressed; the surface of the elytra are regular, showing but little evidence of impressions except for the quadrate foveae; in color, cupreus above, black beneath. The antennae are black, with the first joint and the under surface of joints three, four and five, almost white. The palpi are black with the first joint pale.

The head is narrow with very prominent eyes; the total width including the eyes is less than that of the pronotum. The lateral impressions of the head are broad and deep, reaching from the insertion of the antennae to the posterior third of the eyes. The tooth on the mentum is prominent, parallel and slightly emarginate.

The pronotum is two thirds as long as wide, with a seta in the middle of the lateral margin. The median impression is deep and complete; the posterior impression is broad; the base of the pronotum is strigate.

The elytra are cupreus except for the quadrate impressions and the angulations at the posterior fourth which are bluish. The quadrate impressions are but little wider than the third interval. The striae are straight and punctured, the intervals are convex and very closely punctured.

Holotype. Mackenzie River, 1929 trip, Lot 23, September 23, 1929, O. Bryant collector. Above Sans Sault rapids, 70 miles below Fort Norman. No. 3435 in the Canadian National Collection.

Allotype. Same data, in the Canadian National Collection.

Paratypes. 24, same data.

From *zephyrum* Fall with which this species was confused at first, *bryanti* differs as follows:—*zephyrum* is much larger, much broader relatively; it has a broad central stripe covering a depressed area on the elytra; the antennae and palpi, and the tibiae and tarsi are black; *zephyrum* is more convex than *bryanti* and is distinctly greenish on the under surface. The characters of the last ventral segment of the males vary greatly in the series before the writer. Generally the posterior portion of this segment is strigate; this varies to a condition where the strigose area is smooth and is indicated by four indentations.

Bryant in his diary writes as follows about the habitat of this species:—"Woodpile above Sans Sault rapids, 70-80 miles below Fort Norman, N.W.T.; wide muddy sandbar extending out from bank. *Opisthius* and pitted bronzy

Bembidion on dry windblown sand caught by patches of short sparse grass, well out on sandbar."

Phyllodecta aklaviki n. sp.

Length 4.25 mm. Oblong, elongate, parallel, convex. The head, pronotum, and elytra are metallic blue or bluish green; the under surface and the legs are polished and black, with very little metallic lustre. The first and second antennal joints are pale.

The head is narrower than the pronotum and has a longitudinal median impression; it is punctured with coarse punctures.

The pronotum is much wider than long, the base being wider than the apex. The basal marginal line is very distinct. The disc is sparsely punctured; the sides and base are quite thickly punctured, with very coarse and close punctures in the basal angles.

The elytra are seriately punctured, with the intervals obseletely punctured so that a rugose appearance is produced. The series of punctures are very irregular, more so laterally. The abdominal segments and the under parts are sparsely punctured.

The claws are toothed; the first and third tarsal joints are greatly enlarged, the third being the broader. The antennae are peculiar in possessing brushes of long hair on joints four, five, six and seven, the hairs in the brushes being numerous.

The female differs in having more scanty brushes of hair on the antennae, in the brush on segment seven being absent, and in having the tarsal joints much less expanded.

Holotype. Aklavik N.W.T. August 20, 1930. O. Bryant collector. No. 3436 in the Canadian National Collection.

Allotype. Same data, in the Canadian National Collection.

Paratypes. 100, same data.

This species was taken abundantly on low willows from July 4 to October 1.

This species is most closely allied to *vulgatissima* L., a common species in Europe. Material belonging to this species from England and Germany has been examined. *Vulgatissima* L. has the seriate punctures on the elytra, confused laterally; the head and pronotum are brassy; joints four, five and six only of the antennae have the brushes; the hairs in the brushes are much fewer in number; joints two and three of the antenane are equal in length while in *aklaviki* the relative lengths vary every way. From *americanus* Schaeffer, it is distinguished as follows:—*americanus* has no brushes on the antennae in the female; the elytra are polished and the seriate punctures are regular; the head lacks the longitudinal impression.

Mailed Saturday, September 10, 1932.